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2001 Aerial Detection Survey of the Rocky Mountain Region

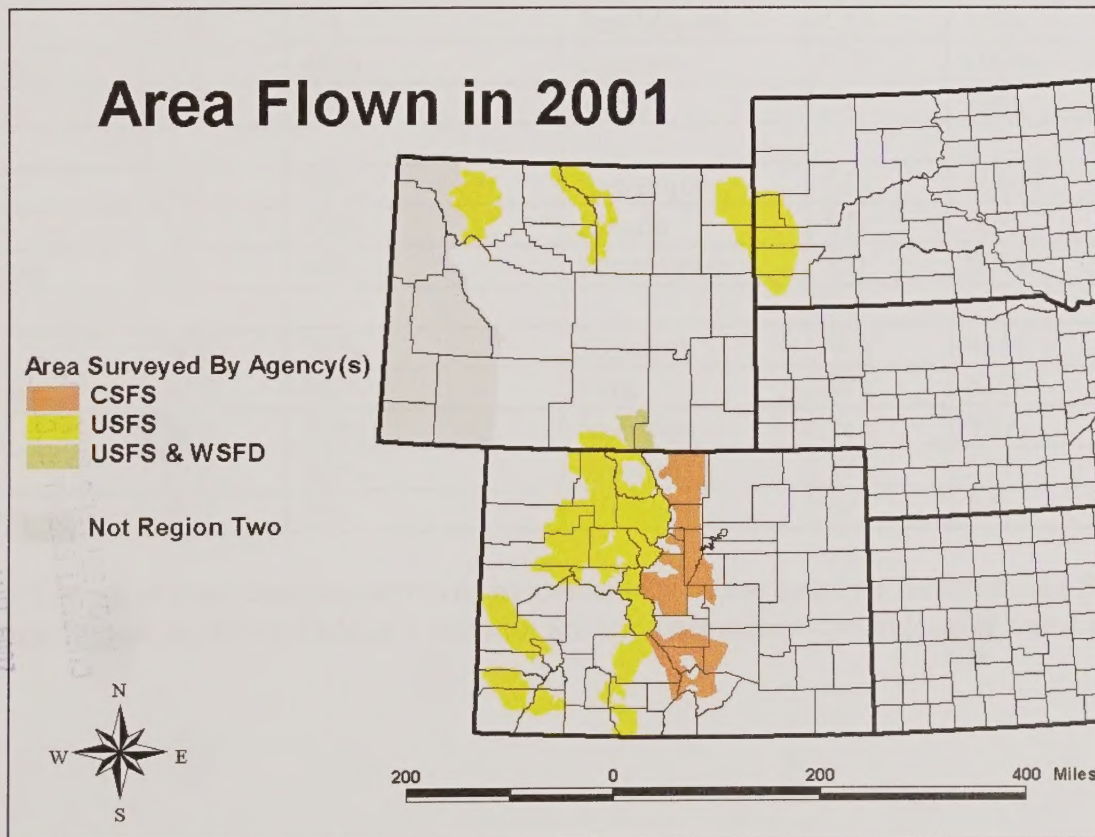
3410 Report - R2-02-09

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General aerial detection surveys of damage and mortality in forest stands due to insects, diseases and other forest health stressors in the Rocky Mountain Region were flown between early July and late September of 2001 by Erik Johnson, Bill Schaupp, Kelly Sullivan, Daniel Long, (USFS Region 2, Forest Health Management), Les Koch (Wyoming State Forestry Division) and Dave Leatherman (Colorado State Forest Service). Approximately 25 million acres were surveyed within the Rocky Mountain Region in 2001 (Figure 1, Table 1). Most of the areas known to have significant forest pest activity in 2001 were included in this survey.

Figure 1. Rocky Mountain Region's 2001 aerial survey coverage by surveying agency.



County	State	% Forested Acres Flown	County	State	% Forested Acres Flown
Alamosa	CO	100%	Jefferson	CO	100%
Archuleta	CO	30%	La Plata	CO	43%
Boulder	CO	87%	Lake	CO	100%
Chaffee	CO	100%	Larimer	CO	71%
Clear Creek	CO	55%	Mesa	CO	45%
Conejos	CO	80%	Mineral	CO	20%
Costilla	CO	50%	Moffat	CO	14%
Custer	CO	83%	Montezuma	CO	37%
Delta	CO	7%	Montrose	CO	48%
Dolores	CO	65%	Ouray	CO	36%
Douglas	CO	93%	Park	CO	83%
Eagle	CO	95%	Pitkin	CO	49%
El Paso	CO	34%	Pueblo	CO	65%
Fremont	CO	43%	Rio Blanco	CO	33%
Garfield	CO	57%	Rio Grande	CO	57%
Gilpin	CO	84%	Routt	CO	99%
Grand	CO	100%	Saguache	CO	75%
Gunnison	CO	7%	San Juan	CO	15%
Hinsdale	CO	1%	San Miguel	CO	15%
Huerfano	CO	48%	Summit	CO	100%
Jackson	CO	98%	Teller	CO	39%
Butte	SD	10%	Lawrence	SD	100%
Custer	SD	95%	Meade	SD	90%
Fall River	SD	80%	Pennington	SD	90%
Albany	WY	36%	Johnson	WY	48%
Bighorn	WY	96%	Park	WY	61%
Carbon	WY	72%	Sheridan	WY	92%
Crook	WY	82%	Washakie	WY	51%
Fremont	WY	3%	Weston	WY	84%

Table 1. Listing of state counties surveyed by percentage of the county's forested area flown. Percentage figures for South Dakota's counties are approximations due to lack of forest cover data.

Due to the nature of aerial surveys, the data and maps within this document will only provide rough estimates of location, intensity and trend information for agents detectable from the air. Many of the most destructive diseases are not represented in this document because these agents are not detectable from aerial surveys. The data presented in this document should only be used as a partial indicator of insect and disease activity, and should be validated on the ground for actual location and casual agent. Shaded areas on maps show locations with tree mortality or defoliation apparent from the air. Intensity of damage is variable and not all trees in shaded areas are dead or defoliated.

The insect and disease data represented in this document are available digitally from the USDA Forest Service, Region Two Forest Health Management group. The cooperators reserve the right to correct, update, modify or replace GIS products. Using these data and maps for purposes other than those for which they were intended may yield inaccurate or misleading results.

Subalpine fir decline

As reported since 1996, the most widespread damages detected in the Rocky Mountain Region were subalpine fir decline. This decline is poorly understood, but it is thought that a combination of insect (the western balsam bark beetle, *Dryocoetes confusus*) and disease (*Armillaria* or other root diseases) play a role in tree decline and mortality. Over 950,000 trees were affected throughout the area surveyed in Region 2 in 2001 by this decline. Since little is known about this decline, it is not possible to determine how much of the damage occurred this past year. Dead subalpine fir holds its red needles longer than most other conifer species, and so it is possible that these totals may be cumulative from the last 2 to 4 years. This decline is present throughout the western United States and Canada; in Region 2, subalpine fir decline is most concentrated in southern and north-central Wyoming, and northern Colorado.

Rocky Mountain Region Bark Beetle Outbreaks

In 2001, there were dramatic increases in tree mortality caused by bark beetles (Figures 2 and 3). Mortality caused by mountain pine beetle (*Dendroctonus ponderosae*) was recorded on all pine species in the Rocky Mountain Region totaling over 840,000 trees. Spruce beetle (*Dendroctonus rufipennis*) populations increased and killed over 250,000 Englemann and blue spruce within the Region. These bark beetle outbreaks continue to be a large forest health management concern.

Figure 2. 2001 aerial survey results depicting mountain pine beetle, spruce beetle, Ips beetles, and Douglas-fir beetle in the northern portion of the USDA Forest Service's Rocky Mountain Region.

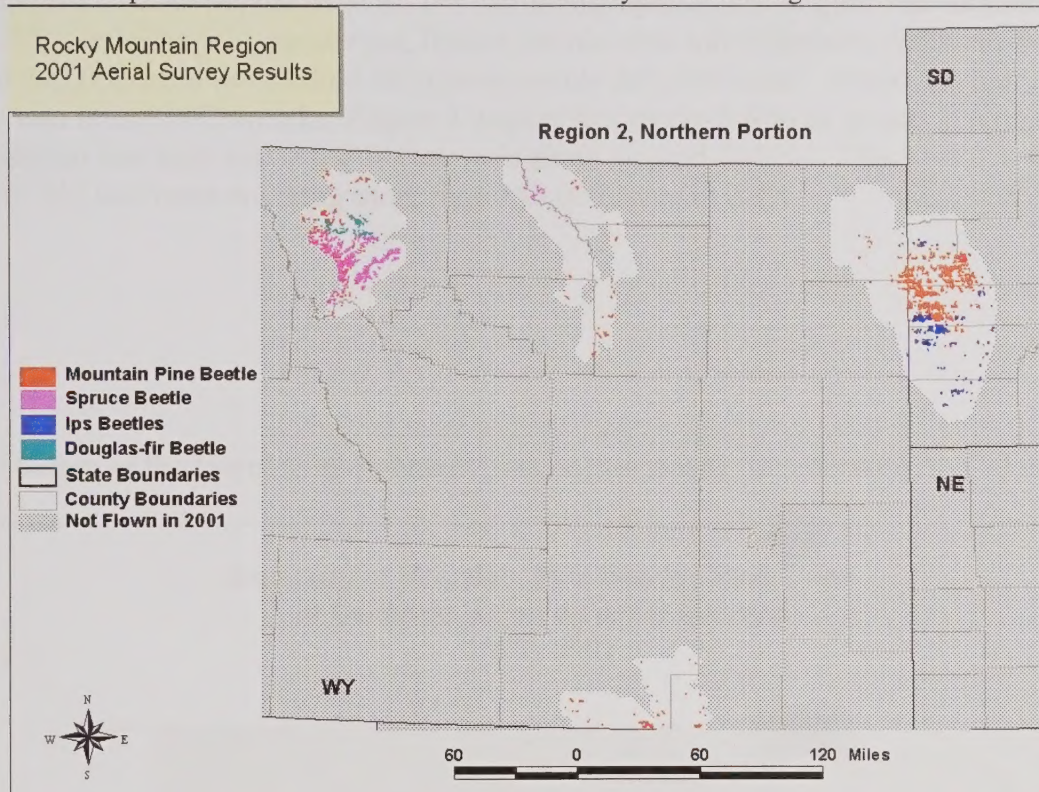
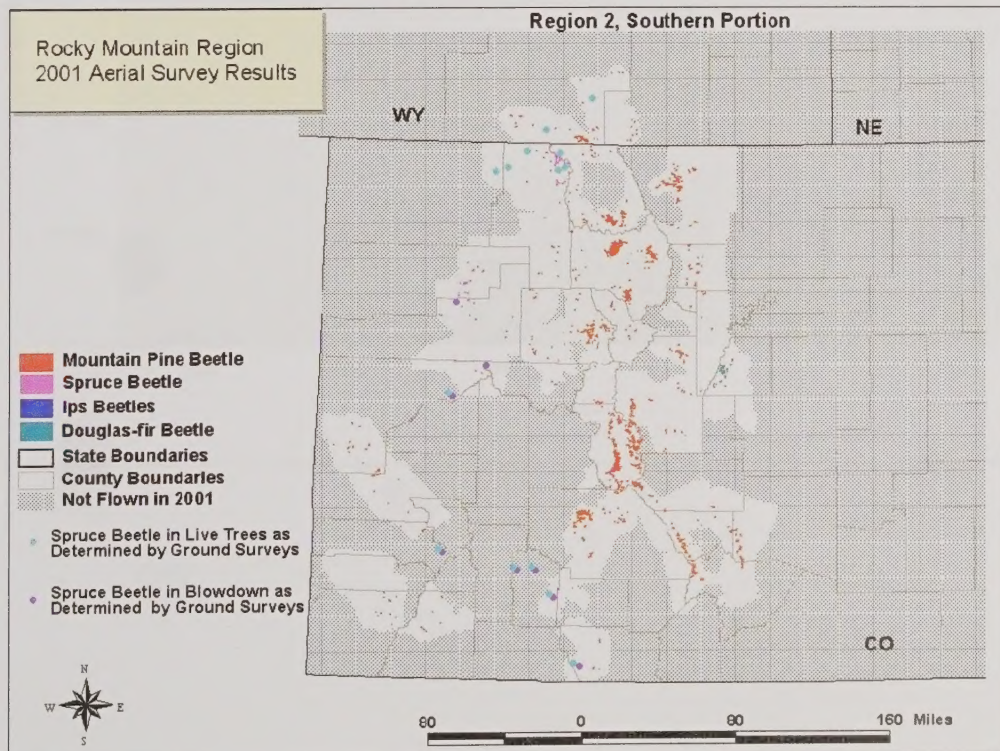


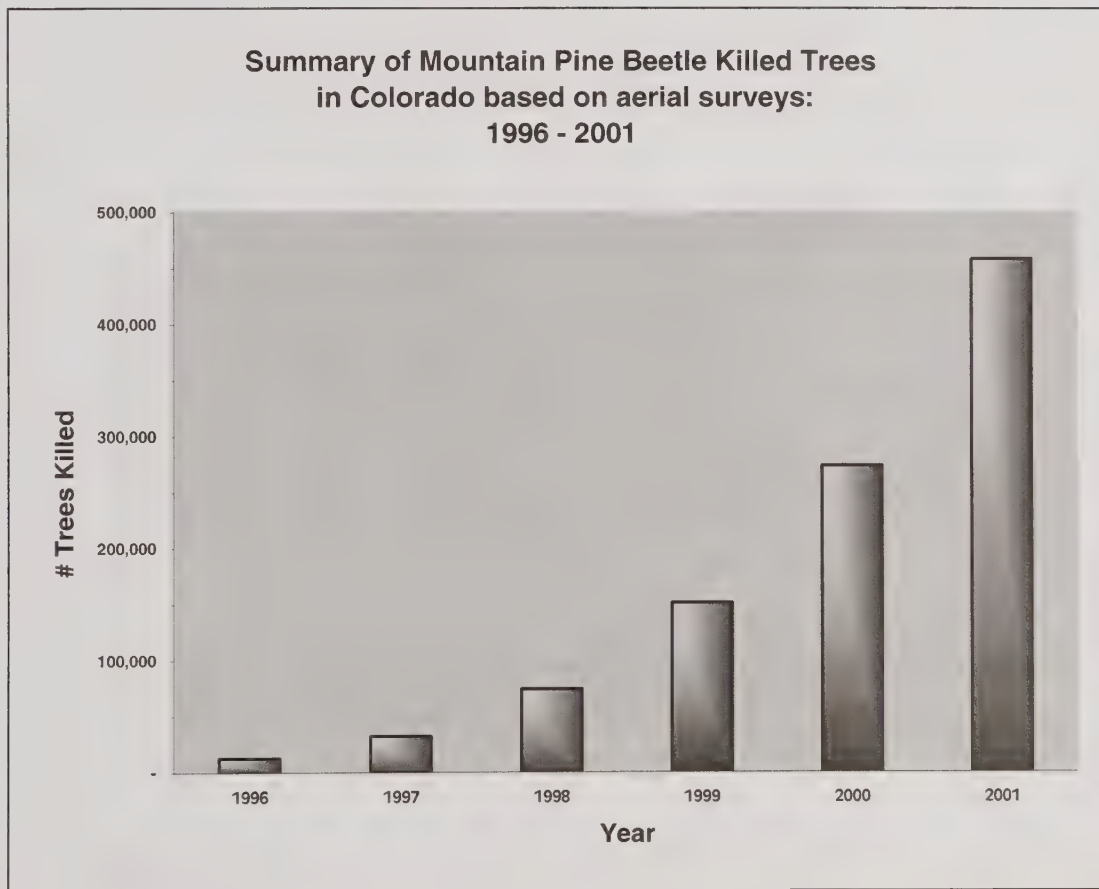
Figure 3. 2001 aerial survey results depicting mountain pine beetle, spruce beetle, Ips beetles, and Douglas-fir beetle in the southern portion of the USDA Forest Service's Rocky Mountain Region. Also included are spruce beetle locations as determined from ground surveys.



Mountain Pine Beetle

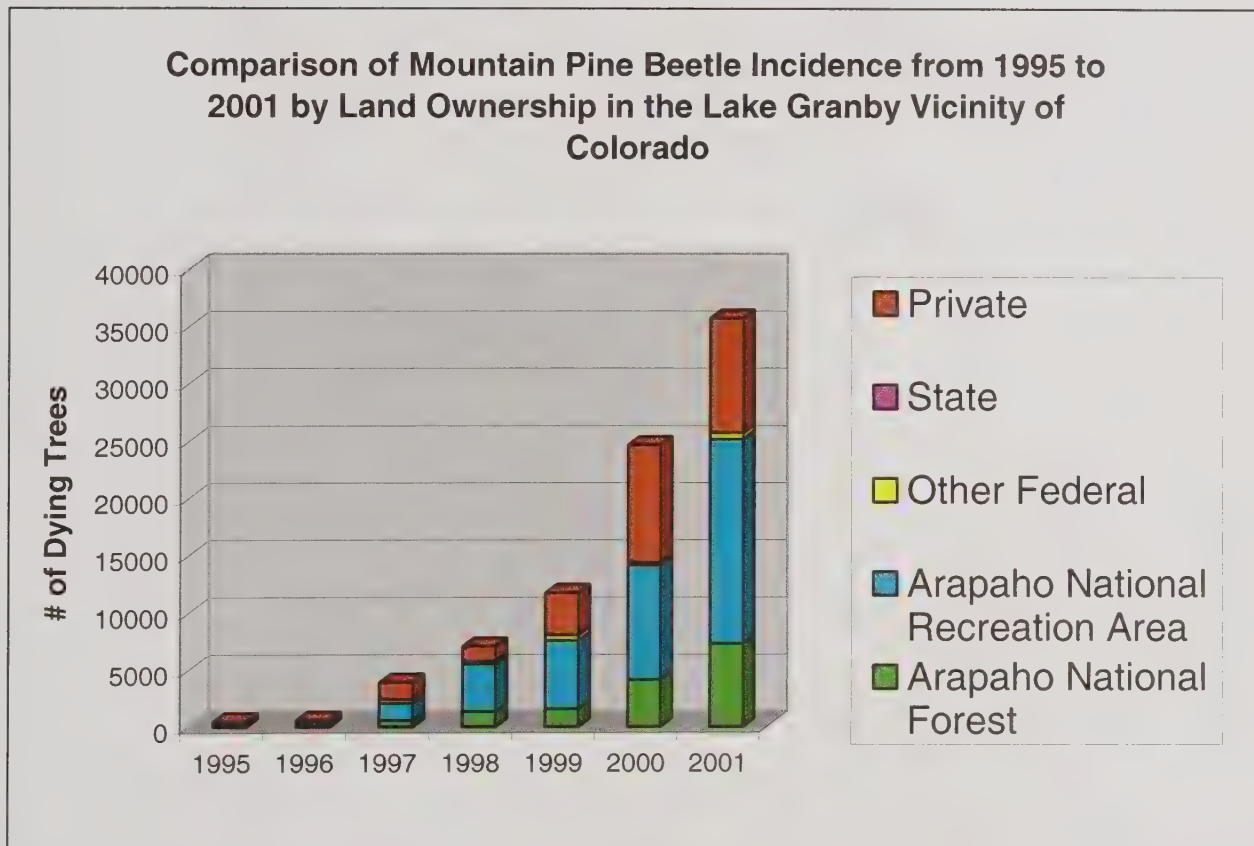
After subalpine fir decline, the most severe damaging agent in the Region was mountain pine beetle (MPB), in lodgepole, ponderosa, limber, bristlecone and whitebark pines. In Region 2, an estimated 840,000 trees were killed on approximately 300,000 acres. More than half of this mortality was found in Colorado. Figure 4 depicts the yearly 2-fold or greater increase in MPB-killed trees that has been occurring in Colorado since the mid-1990's. This beetle in Colorado killed over 450,000 trees covering more than 150,000 acres in 2001.

Figure 4: Graph of the increase in mountain pine beetle-caused tree mortality in Colorado



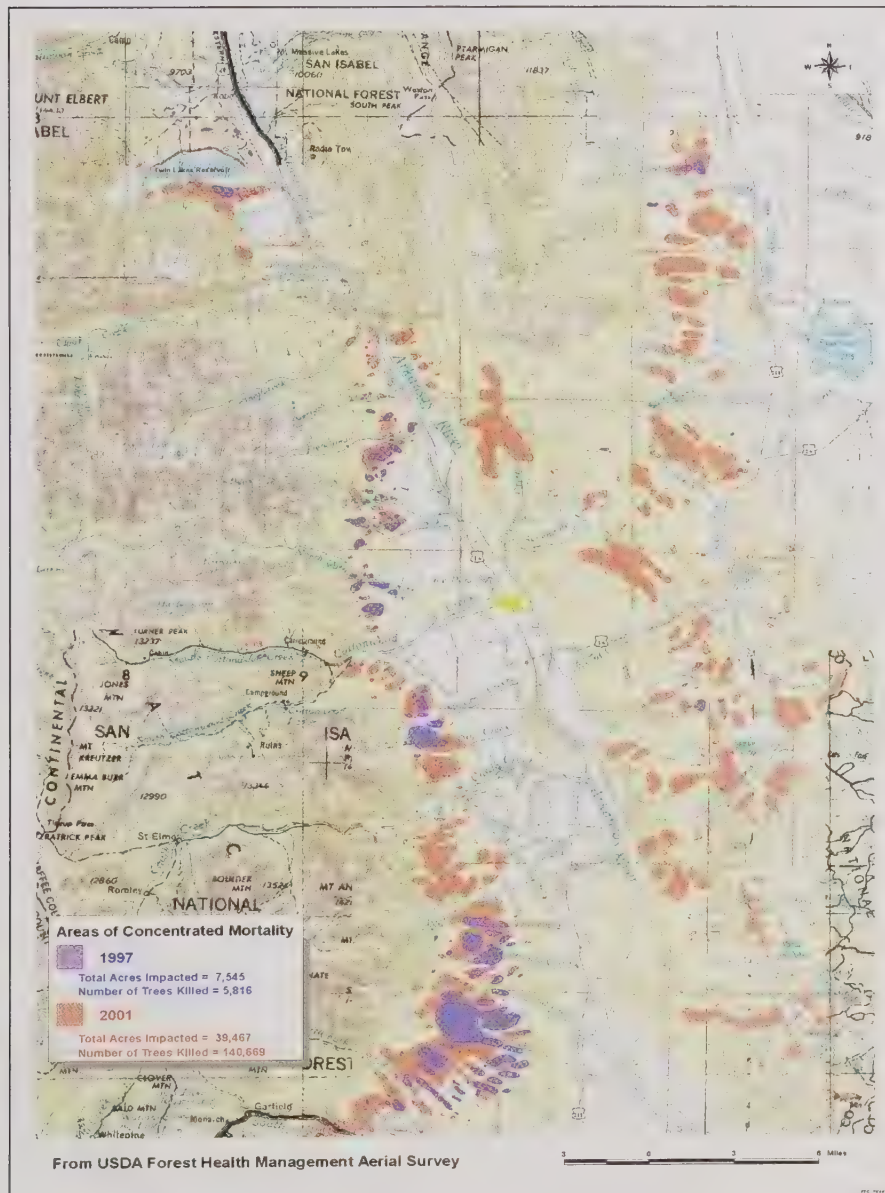
Grand County, CO had the largest amount of MPB killed trees in Region 2, totaling over 150,000, which is more than double 2000's aerial survey total of 65,000 dead lodgepole pines (Figure 5). The areas that continue to experience the most MPB activity is around Lake Granby, along the William's Fork River near the Henderson Mine, and throughout the Troublesome Creek watershed. The following graph illustrates the increasing trend of mountain pine mortality (by ownership) in Grand County within a study area in the vicinity of Lake Granby (T.2N & 3N, R.75W & 76W):

Figure 5.



The second largest area containing mortality attributed to the mountain pine beetle in Region 2 was found in **Chaffee County, CO**, most notably between Salida and Granite along the eastern foothills of the Sawatch Range, primarily in ponderosa pine. The total number of trees killed within the county in 2001 was approximately 140,000 trees. The increasing trend of mountain pine beetle activity is well illustrated by the following map (Figure 6) of the upper Arkansas Valley (Chaffee Park and Lake Counties) comparing 1997 and 2001 aerial survey results.

Figure 6. **Mountain Pine Beetle Activity in the Upper Arkansas Valley**
Flown Summers 1997 and 2001



Three out of the next four highest numbers for MPB mortality by county in 2001 in Region 2 were found in **Meade, Pennington, and Lawrence Counties** of South Dakota. The totals there were 110,000, 98,000 and 61,000 trees respectively. The Black Hills are within these counties and overall within the Hills, including Wyoming's side, more than 290,000 trees, all Ponderosa Pines, were estimated to have been killed by the beetle. The area on the Black Hills with the highest amount of MPB activity continues to be in the Beaver Park vicinity, about five miles south of Sturgis, SD. Almost 100,000 trees were estimated to have been killed within this area in 2001. The six-year trend for this area is depicted in the following graph (Figure 7).

Figure 7.

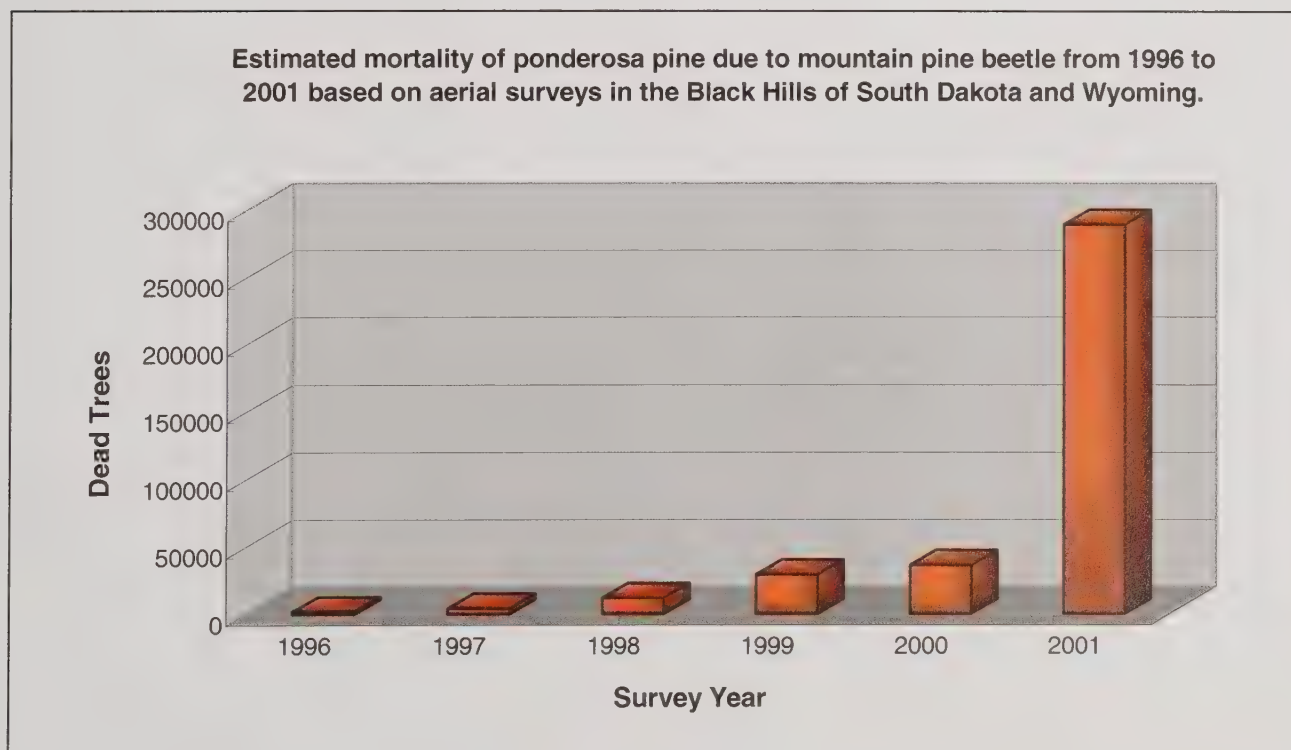


This was the sixth consecutive year of increased beetle-caused tree mortality in the Black Hills. In 1996, there were about 1,500 trees killed by mountain pine beetle compared to nearly 300,000 this year. Therefore, tree mortality has increased nearly 200 times over five years. The following chart depicts this trend (Figure 8).

In addition to the mortality attributed to mountain pine beetle, the 2001 aerial survey determined that over 170,000 ponderosa pines were killed by pine engraver beetles (*Ips* species) in the Black Hills. This unprecedented level of *Ips* activity is a consequence of wildfires and weather events, such as hail and snow-breakage, which have occurred over the past few years. *Ips* beetles bred in this weakened and damaged tree material. With a nearly unlimited supply of food, the *Ips* beetle populations increased significantly. Now that this food supply is becoming less suitable, *Ips* have exited it and are killing standing trees.

Bark beetles, therefore, killed a total of more than 460,000 ponderosa pine, in 2001 in the Black Hills National forest and environs. Because it is not always possible to distinguish *Ips* from mountain pine beetle activity during aerial survey, the exact proportion due to each beetle species may differ from what is reported. Only ground surveys could provide a more accurate estimate.

Figure 8.



Park County, WY had the fifth highest MPB total within the Region in 2001. An estimated 69,000 trees were reported to have been killed here. The majority of damage was thought to be occurring in white bark pine, with the remainder in limber pine; almost all of which was found within the upper reaches of the South Fork of the Shoshone River watershed. The majority of the polygons attributed to mountain pine beetle were also attributed to white pine blister rust (*Cronartium ribicola*). Because limber and whitebark pines are susceptible to white pine blister rust, needle casts, and pine engraver beetles (*Ips* spp.) in addition to MPB, it is impossible to determine exactly what agent or combination of agents are responsible for the mortality without ground surveys (also see section on *White Pine Blister Rust and Limber Pine Decline*).

Eagle County, CO had the seventh highest number of trees killed by MPB in R2. The Vail Valley and the Eagle River Valley continue to experience heavy losses from MPB in lodgepole pine. The estimated total for tree mortality was approximately 46,000.

The MPB outbreak in **Saguache County, CO**, which has the eighth highest countywide MPB total, is basically a southwesterly continuation of the outbreak started in the upper Arkansas Valley that took root in Chaffee County. The ponderosa pines of the Cochetopa Hills are receiving the brunt of this mortality, particularly those trees east of the Continental Divide near Hwy. 114. The countywide total is estimated to be at 41,000 trees.

In **Jackson County, CO**, which is ninth in R2 counties in MPB numbers, over 37,000 trees succumbed to MPB mortality. This represents over a five-fold increase from 2000's total of approximately 6,500 trees, countywide. The outbreak near Rand, between Buffalo Ridge, Green Ridge and Owl Mountain, continues to enlarge.

MPB mortality is present and on the rise throughout many areas in R2 (Table 2), including the eastern slope of the Bighorn Mountains, the eastern slope of the Sierra Madre Mountains, the eastern slope of the Sangre de Cristo Mountains and the Wet Mountains. Colorado's Front Range numbers were down in 2001.

Table 2. Listing of counties in Region 2 with mountain pine beetle-caused tree mortality. The counties are listed by decreasing amounts of damage.

County (State)	Approximate Number of Trees Killed
GRAND (CO)	153,573
CHAFFEE (CO)	136,140
MEADE (SD)	110,369
PENNINGTON (SD)	97,878
PARK (WY)	68,855
LAWRENCE (SD)	60,968
EAGLE (CO)	46,348
SAGUACHE (CO)	41,487
JACKSON (CO)	37,450
CROOK (WY)	10,577
CARBON (WY)	9,970
LAKE (CO)	7,513
LARIMER (CO)	6,687
JOHNSON (WY)	6,082
PARK (CO)	5,550
SUMMIT (CO)	5,467
WESTON (WY)	4,937
CUSTER (SD)	4,095
MESA (CO)	3,702
ALBANY (WY)	3,279
CUSTER (CO)	2,872
BIG HORN (WY)	2,622
WASHAKIE (WY)	2,615
ROUTT (CO)	2,140
SHERIDAN (WY)	1,818
PUEBLO (CO)	1,398
SAN MIGUEL (CO)	1,375
HUERFANO (CO)	1,175
BOULDER (CO)	949
FREMONT (CO)	887
JEFFERSON (CO)	845
PITKIN (CO)	547
LA PLATA (CO)	342
FREMONT (WY)	270
GUNNISON (CO)	252
MONTEZUMA (CO)	240
RIO BLANCO (CO)	222
DOUGLAS (CO)	171
RIO GRANDE (CO)	148
MONTROSE (CO)	131
GILPIN (CO)	114
CONEJOS (CO)	104
DOLORES (CO)	63

Spruce Beetle

In 2001, tree mortality from the spruce beetle, *Dendroctonus rufipennis*, almost doubled compared to survey data collected in 2000. The 2001 survey counts increased 10-fold from the 1999 data, making spruce beetle the third most damaging agent in R2 detected by aerial surveys. Over 260,000 trees across 74,000 acres were believed to have been affected by the beetle (Figures 2 and 3, Table 3). Because beetle-killed spruce trees lose their needles quickly, it is often hard to discern spruce beetle activity from the air. Therefore, it is probable that some spruce beetle activity went unseen during the 2001 aerial detection survey.

In Park County, WY, the spruce beetle epidemic raged on, nearly doubling 2000's figure of 130,000 trees killed to nearly 240,000 trees killed in 2001. This infestation is located throughout the northern Absaroka Mountains and is occurring in the Shoshone and Bridger-Teton National Forests, and in Yellowstone National Park.

In the northern Bighorn Mountains, spruce beetle mortality in Bighorn, Sheridan and Johnson Counties, WY increased in 2001. The cumulative mortality figure for these three counties was just under 5,000 trees, which was more than double 2000's total.

For the first time since the Routt Divide blowdown flattened 20,000 acres of high elevation spruce, fir and lodgepole pine on October 25, 1997, resulting losses in live, standing spruce trees in north-central Colorado has become reality. Within Routt, and Jackson Counties, CO, over 11,000 spruce trees were killed. In 2000, only 70 trees were reported as being SB killed in these two counties.

Nearby in the Flat Tops of Rio Blanco, Garfield, and Moffat Counties, CO, spruce beetle killed trees are also on the rise. Spruce beetle within these three counties, predominately throughout the western half of the Flat Tops killed an estimated 3,500 trees, which is more than double 2000's figure across a comparable area. Ground surveys confirming the presence of spruce beetles in standing trees have been conducted in similar areas of the Flat tops.

Aerial surveys also detected dying spruce in the Eagle's Nest Wilderness Area (Booth Creek), on the Uncompahgre Plateau, south of Eagle, Colorado, and in the southern San Juan Mountains. The mortality in Conejos County, CO near La Manga Pass on the Rio Grande National Forest declined from over 2,700 trees killed in 2000 to only 135 trees in 2001.

Table 3. Listing of counties in Region 2 with spruce beetle-caused tree mortality. The counties are listed by decreasing amounts of damage.

County (State)	Approximate Number of Trees Killed
PARK (WY)	238,810
ROUTT (CO)	9,826
BIG HORN (WY)	2,776
SHERIDAN (WY)	1,833
RIO BLANCO (CO)	1,777
JACKSON (CO)	1,617
GARFIELD (CO)	1,489
EAGLE (CO)	408
MESA (CO)	347
MOFFAT (CO)	307
JOHNSON (WY)	240
MONTROSE (CO)	176
FREMONT (WY)	165
CONEJOS (CO)	135
PITKIN (CO)	132
CARBON (WY)	118
GRAND (CO)	64
MONTEZUMA (CO)	55
GUNNISON (CO)	51
SAN MIGUEL (CO)	34
ARCHULETA (CO)	24
OURAY (CO)	18
WASHAKIE (WY)	6

Douglas-fir beetle

The fourth most active damaging agent detected in the 2001 survey was the Douglas-fir beetle (DFB), *Dendroctonus pseudotsugae*. This beetle accounted for an estimated 22,855 dead trees covering an estimated 21,029 acres, which is below 2000's region-wide total of 34,353 dead trees (Figures 2 and 3, Table 4). Most of this drop can be contributed to significant mortality decreases in Park County, WY and Saguache County, CO.

While still high, Park County, WY's 2001 total for DFB mortality of 15,645 is nearly half of 2000's figure. Most of this mortality is again occurring throughout the North and South Forks of the Shoshone River.

In Douglas County, CO, approximately 2,200 dead trees were attributed to DFB. This figure is slightly lower than 2000's number and significantly lower than 1999's total. Although the DFB mortality continues within this area of the South Platte River watershed following the major disturbances of the 1993-1995 Douglas-fir tussock moth, *Orgyia pseudotsuga*, outbreak and the 1996 Buffalo Creek fire, mortality appears to be downward trending.

DFB mortality in Saguache, County, CO saw a dramatic decrease in 2001, where only 435 trees were killed by DFB in 2001 compared to an estimated 3,640 trees detected in 2000. DFB and the resulting mortality has been present in generally low densities throughout the Saguache Creek watershed for over 10 years now, attacking trees weakened by endemic, but chronic, populations of western spruce budworm. Further to the south, in Conejos County, CO, nearly 400 trees were affected in a similar way.

Most of the mortality in Garfield County, CO (approximately 900 trees) is occurring in small, scattered pockets in the southern Flat Tops north of I-70 between Glenwood Springs and Rifle.

Other areas in R2 with DFB mortality include: the upper San Miguel Canyon; east of State Bridge, CO; east of Glenwood Springs, CO along the south rim of Glenwood Canyon; and above the Dolores River south of Stoner, CO.

TABLE 4. Listing of counties in Region 2 with Douglas-fir beetle-caused tree mortality. The counties are listed by decreasing amounts of damage.

County (State)	Approximate Number of Trees Killed
PARK (WY)	15,645
DOUGLAS (CO)	2,202
GARFIELD (CO)	909
MONTEZUMA (CO)	487
SAGUACHE (CO)	435
CHAFFEE (CO)	396
CONEJOS (CO)	379
EAGLE (CO)	290
LA PLATA (CO)	243
PUEBLO (CO)	240
WASHAKIE (WY)	236
FREMONT (CO)	206
MESA (CO)	145
DOLORES (CO)	142
MONTROSE (CO)	135
CARBON (WY)	128
JEFFERSON (CO)	114
ROUTT (CO)	77
BIG HORN (WY)	76

Western spruce budworm

Western spruce budworm (WSBW), *Choristoneura occidentalis*, activity was again on the rise in 2001, with an estimated 36,500 acres affected (Table 5 and Figure 9). This represents nearly a 70% increase over 2000's region-wide total of 21,570 defoliated acres.

Once again, most of the WSBW activity in Region 2 was detected in southern Colorado. This regional phenomenon corresponds with aerially observed WSBW increases made in northern New Mexico and northeastern Arizona. The total WSBW defoliated acreage detected during the 2001 aerial survey in southern Colorado is estimated to be 35,715, and includes the following counties: Conejos, Custer, Hinsdale, La Plata, Mineral, Montrose, Ouray, Rio Grande and Saguache. The actual acreage defoliated in southern Colorado could be several times higher as many areas were not surveyed there in 2001 (see figure 1 showing the area surveyed and the surveying agency, and appendix 1 listing counties surveyed by percentage of the county's forested area flown).

In the Medicine Bow Mountains of southern Wyoming, an estimated 765 acres (**Albany and Carbon Counties**) were defoliated by WSBW, which is slightly lower than 2000's number for this area. Most of this defoliation is taking place in and around the North Platte River valley on the range's western slopes.

TABLE 5. Listing of counties in Region 2 with approximate acres affected by Western Spruce Budworm. The counties are listed by decreasing amounts of damage.

COUNTY	ACRES AFFECTED (APPROXIMATE)
LA PLATA (CO)	16,765
MONTROSE (CO)	8,790
OURAY (CO)	3,829
CONEJOS (CO)	3,454
MINERAL (CO)	1,201
RIO GRANDE (CO)	1,169
CARBON (WY)	627
CUSTER (CO)	322
SAGUACHE (CO)	183
ALBANY (WY)	138
JACKSON (CO)	14
HINSDALE (CO)	3
TOTAL	36,494

Figure 9. Aerial survey results of 2001 depicting western spruce budworm defoliation in the southern portion of the USDA Forest Service's Rocky Mountain Region.

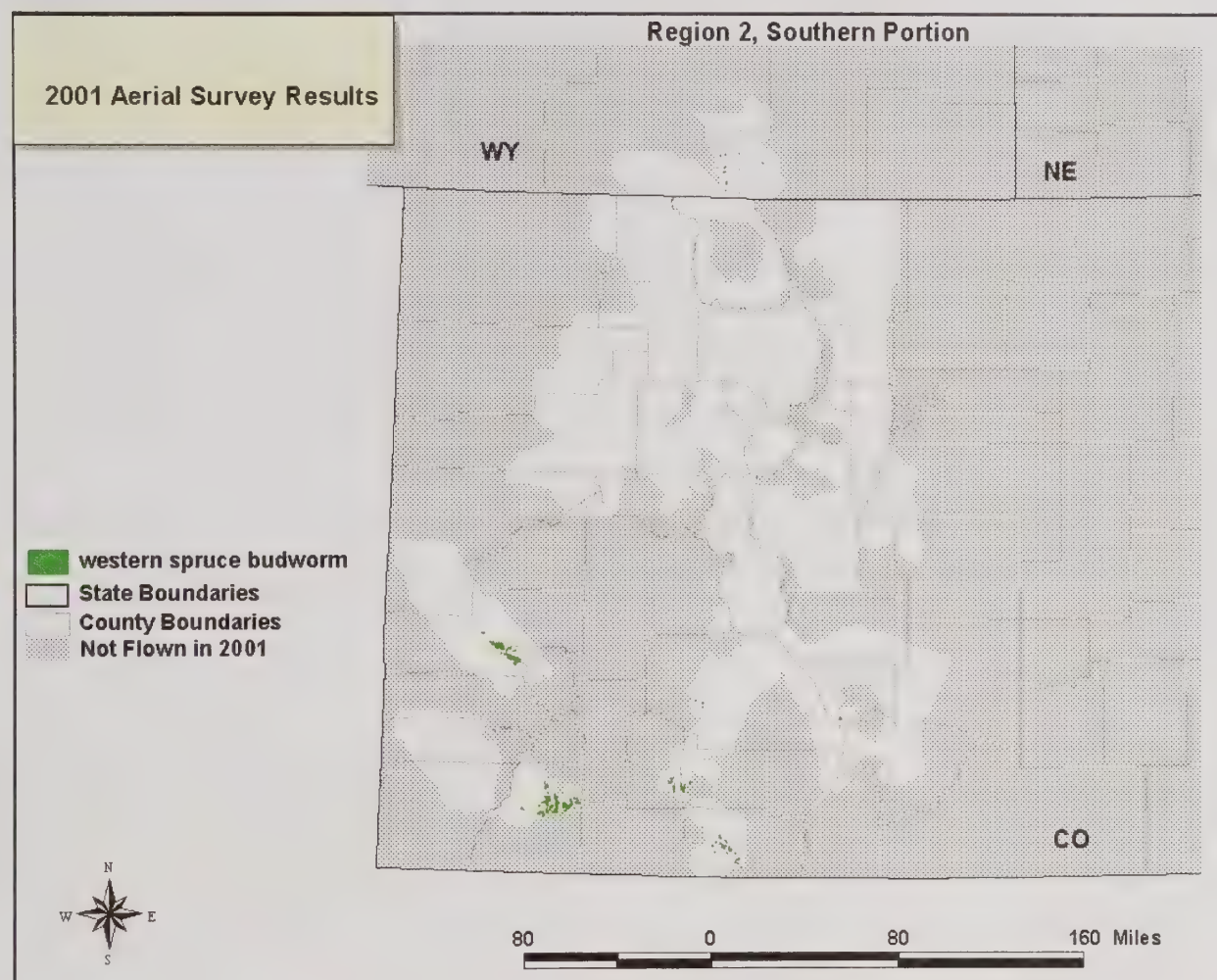


Table 6. Summary Table of state totals for the most damaging forest insects detected in the 2001 aerial survey in Region 2.

State	Mountain Pine Beetle (# OF TREES)	Douglas- Fir Beetle (# OF TREES)	Spruce Beetle (# OF TREES)	Western Spruce Budworm (# OF ACRES)
Colorado	457,892	6,400	16,460	35,408
Wyoming	111,025	16,085	234,948	1,087
South Dakota	273,310	-	-	-
TOTALS	842,227	22,485	251,408	36,495

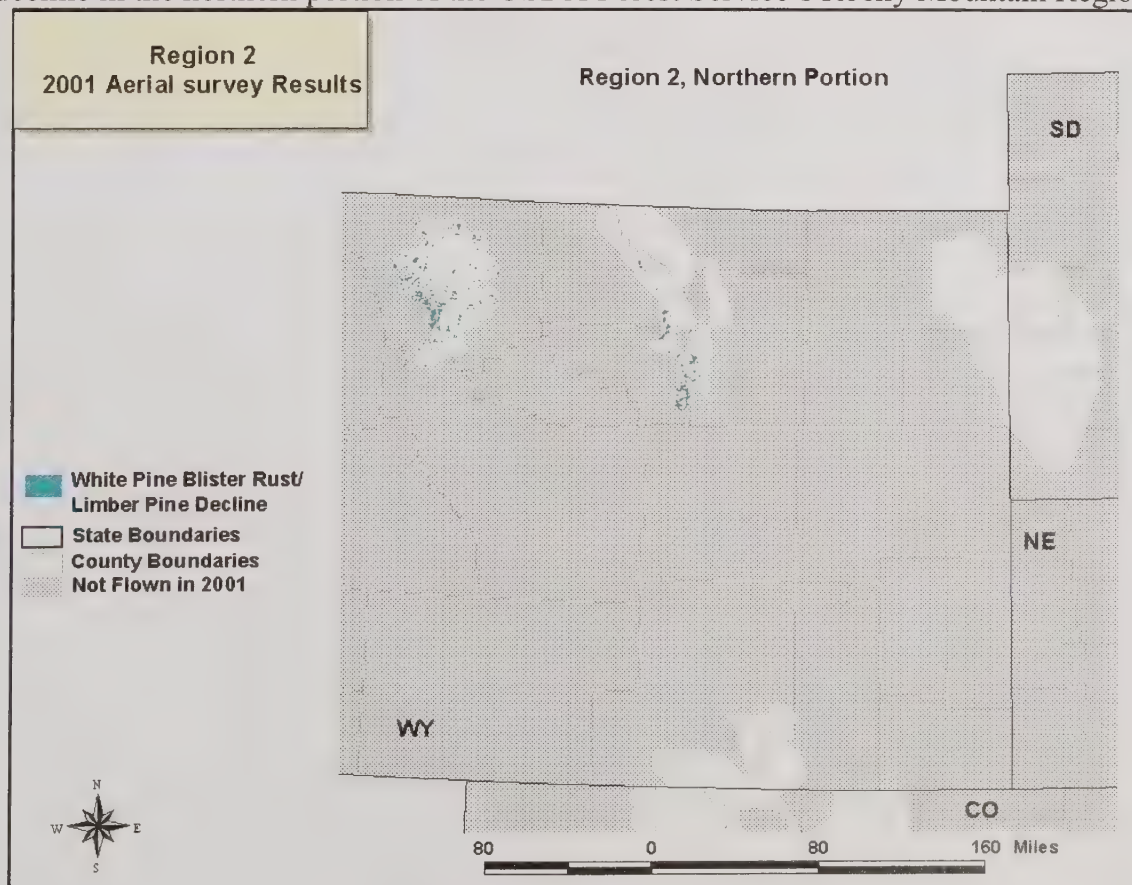
White Pine Blister Rust & Limber Pine Decline

Some cases in which limber pines appear either off-color or decadent from the air are attributed as "limber pine decline." The ambiguity is due to the difficulty of discerning from the plane among the numerous pathogens and insects that contribute to limber pine decline. This decline is poorly understood, but it is thought that a combination of insects (mountain pine beetle [*Dendroctonus ponderosae*], and pine engraver beetles [*Ips* spp]), diseases (white pine blister rust, [*Cronartium ribicola*], dwarf mistletoe [*Arceuthobium cyanocarpum*], and various needle casts), plus abiotic factors such as winter-injury play a role in tree decline and mortality.

Some cases in which whitebark pine appear either off-colored or decadent from the air are coded as white pine blister rust. This disease, affecting all five-needle pines, has been present in Wyoming for several decades. Although white pine blister rust is generally credited as being the primary killer of whitebark pine in the west, whitebark pine is also susceptible to the same damage agents affecting the limber pine described above. Therefore, this phenomenon can also be thought of as "whitebark pine decline."

Approximately 46,000 acres in northern Wyoming in the counties of Big Horn, Fremont, Johnson, Park, Sheridan and Washakie are estimated to be affected by white pine blister rust and/or limber pine decline (Figure 10).

Figure 10. Aerial survey results of 2001 depicting areas with white pine blister rust or limber pine decline in the northern portion of the USDA Forest Service's Rocky Mountain Region.



Miscellaneous Tree Damages

In 2001, damages from miscellaneous diseases, insects, and abiotic factors were found in Colorado during the aerial detection surveys (Figure 11). Throughout much of the area surveyed in southern Colorado, widespread discoloration in Ponderosa Pine could be seen. This discoloration is thought to be due to *Davisomycella* needle blight *Davisomycella sp.*, a fungi affecting the tree's needles. This needle disease was also noted in 1999 and 2000 in southern Colorado. Approximately 6,700 acres of this damage was recorded in southern Colorado. Needle casts seldom cause mortality, but when present for several years in a row, will cause reductions in growth.

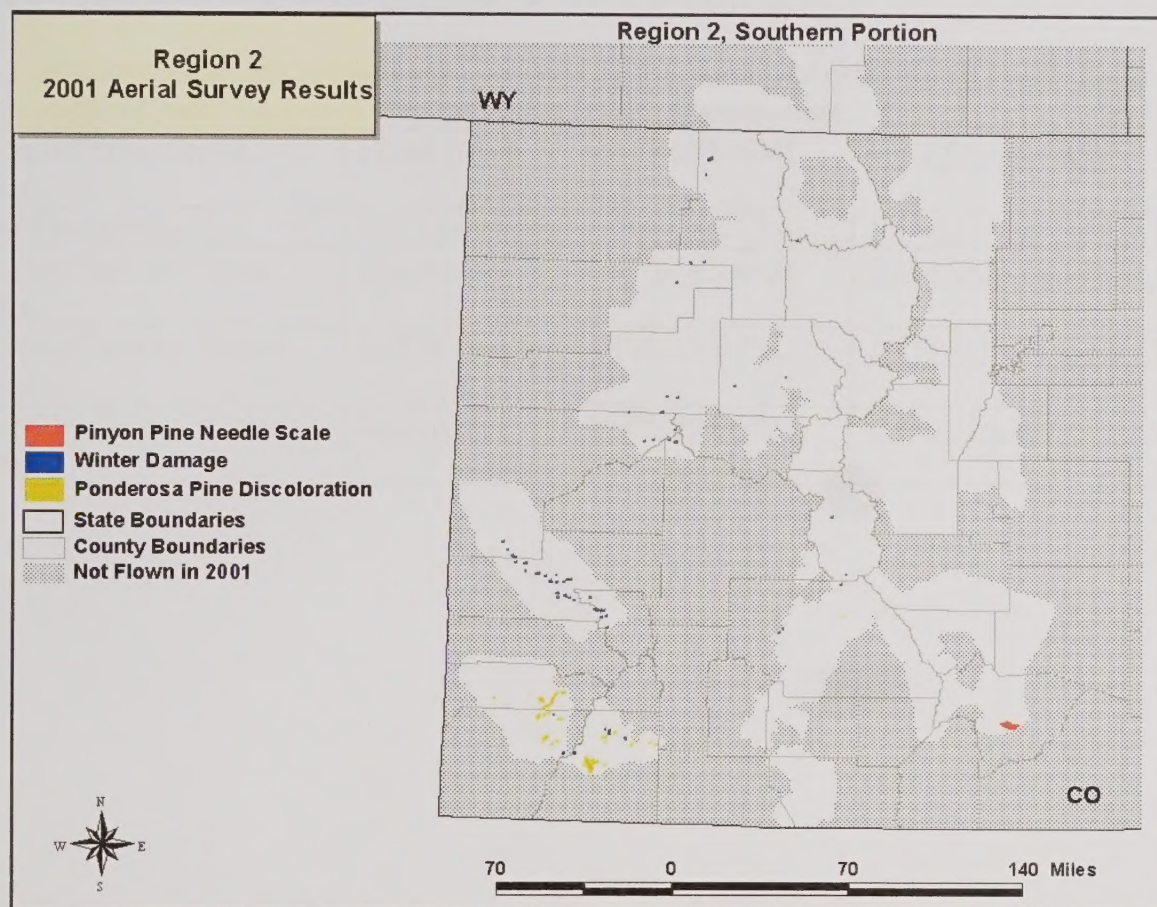
Over 10,000 acres of discolored trees caused by the pinyon pine needle scale, *Matsucoccus acalyptus*, were mapped in Huerfano County, CO across a broad area six miles north of La Veta. This has been verified on the ground. This needle scale affects trees by killing branch tips and causing needle injury. Very seldom will the scale activity kill trees, but it can weaken trees, predisposing them to bark beetle attacks.

A late spring snowstorm in June 2001 decimated much of the new growth produced by several of Region 2's tree species. In general, broadleaf species were hit the hardest, but bud kill was also seen on subalpine fir and spruce trees. Where possible, this phenomenon was mapped during the 2001 aerial survey. Most of this "winter damage" was mapped in the aspen and gambel oak forest types because the visible signature was more apparent. Approximately 7,300 acres of this damage was recorded in Colorado (Figure 11).

Mortality due to fire, both natural and human-caused, is often mapped during aerial survey missions. Information on the intensity of the resulting tree mortality is, at times, also recorded. In Region 2, nearly 20,000 acres of fire-caused tree mortality was mapped throughout thirty-two R2 counties during the 2001 field season. Over one-third of the total fire mortality acreage was recorded in the southern Black Hills as a result of the 2001 Elk Creek fire complex.

An estimated 600 acres of wind-throw region wide was detected in 2001. It was found within sixty-three R2 counties. Except for blow down that spans a fairly large area (10 acres or more) with most of the trees in the affected area being down, aerial detection of this damage is very difficult during the annual "general" or "overview" aerial survey. Even with a "special" survey focused only on detecting wind-throw, it is often missed because the downed tree's needle color remains the same as the surrounding standing trees. Scattered areas of blow down will often go undetected unless the flight path is very close to the damage area. It is therefore probable that some wind-thrown areas were missed during the 2001 survey.

Figure 11. Aerial survey results of 2001 depicting areas with miscellaneous insect, disease, and abiotic damages in the southern portion of the USDA Forest Service's Rocky Mountain Region.



Aerial Survey Data

2001's aerial survey data for the state of Colorado is available in digital format for use in a Geographic Information System (GIS) database. The files can be found at the following FTP address: ftp://ftp.fs.fed.us/incoming/r2/ro/aerial_survey/2001/ (please note that the *entire* pathway must be typed). Download the forest damage coverage (r201_dmg.e00) and the areas flown and not flown coverage (r201_flown.e00). ArcView shapefiles are also available at this site. In addition to the GIS files, please open the folder entitled "meta_data" ftp://ftp.fs.fed.us/incoming/r2/ro/aerial_survey/meta_data/ and download the three documents explaining the fields in the polygon attribute tables (PAT): the *Aerial Survey Geographic Information System Handbook: Sketchmaps to Digital Geographic Information* (gis_handbook.pdf), the PAT explanation document (about_pat_table.xls), and the USFS Region 2 "pest code" document (r2_pest_codes2000.doc). The *Aerial Survey Geographic Information System Handbook: Sketchmaps to Digital Geographic Information*, is also available at the Forest Health Technology Enterprise Team's (FHTET) Forest Health website:

http://www.fs.fed.us/foresthealth/id/id_guidelines.html (bottom of page). For additional information regarding the GIS data, please contact Steve Gregonis sgregonis@fs.fed.us 303-275-5017, or Erik Johnson ejohnson02@fs.fed.us 303-236-8001.

If you have any questions or comments concerning this survey or other forest health issues, please contact Rocky Mountain Region Forest Health Management.

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